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Lee

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(54) **POWDER PROTECTING THREE-WAY VALVE**

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F16K 11/087 (2006.01)
F16K 27/06 (2006.01)

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CPC ***H01L 21/67017*** (2013.01); ***F16K 11/0876*** (2013.01); ***F16K 27/067*** (2013.01)

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(Continued)

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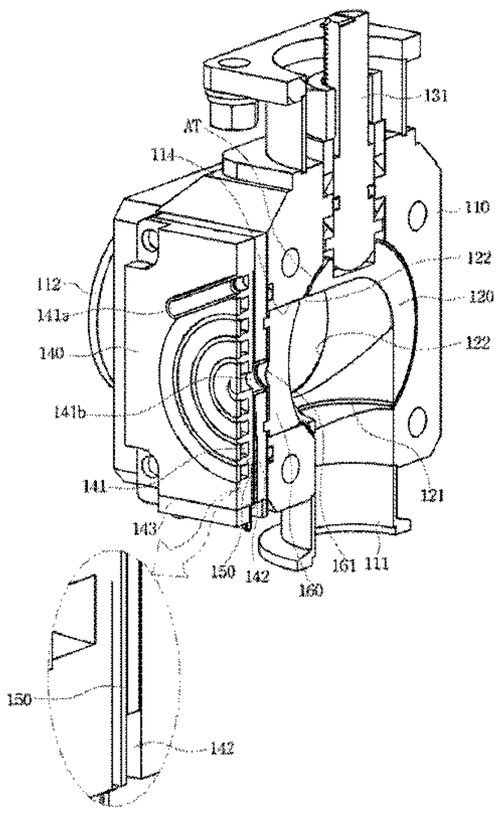
(57) **ABSTRACT**

Disclosed is a powder protecting three-way valve for a semiconductor or flat panel display manufacturing apparatus, including: a valve casing including an inlet and a plurality of outlets; a rotating ball rotatably installed in the valve casing to control a flow direction of reaction by-product gas; a nitrogen gas supply member which receives nitrogen gas from an outside, guides a flow of the nitrogen gas using a guide path, and supplies the nitrogen gas into the valve casing to prevent a powder contained in the reaction by-product gas from accumulating in the valve casing; and a heating unit installed in the nitrogen gas supply member to heat the nitrogen gas passing through an interior of the nitrogen gas supply member. The nitrogen gas supply member is formed as a thin flat body pressed against one side surface of the valve casing and is integrally coupled to the valve casing.

8 Claims, 9 Drawing Sheets



(58) **Field of Classification Search**
CPC F16K 5/0605; F16K 25/02; F16K 25/04; H01L 21/67017
See application file for complete search history.

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FIG. 1

-Prior Art-

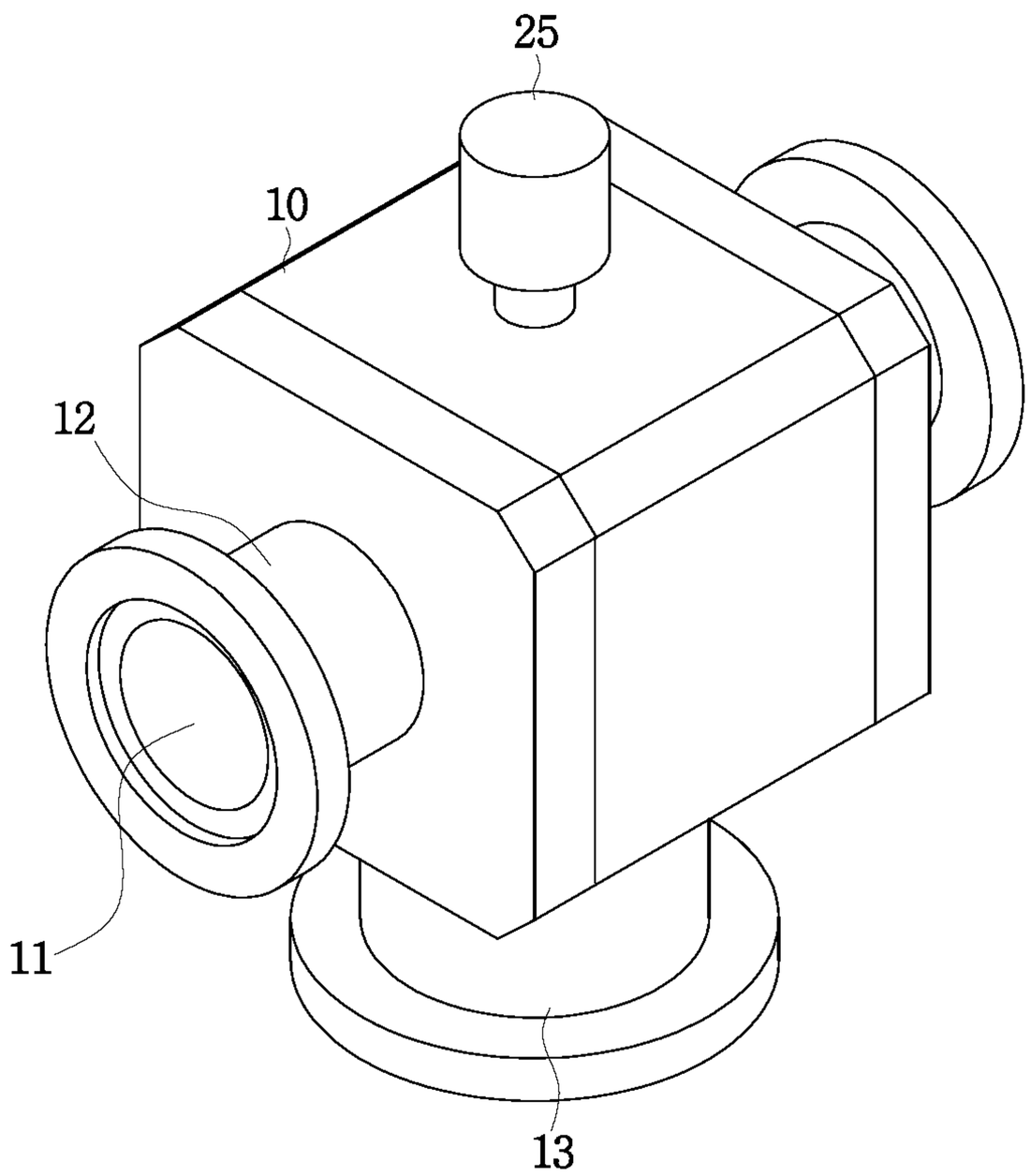


FIG. 2

-Prior Art-

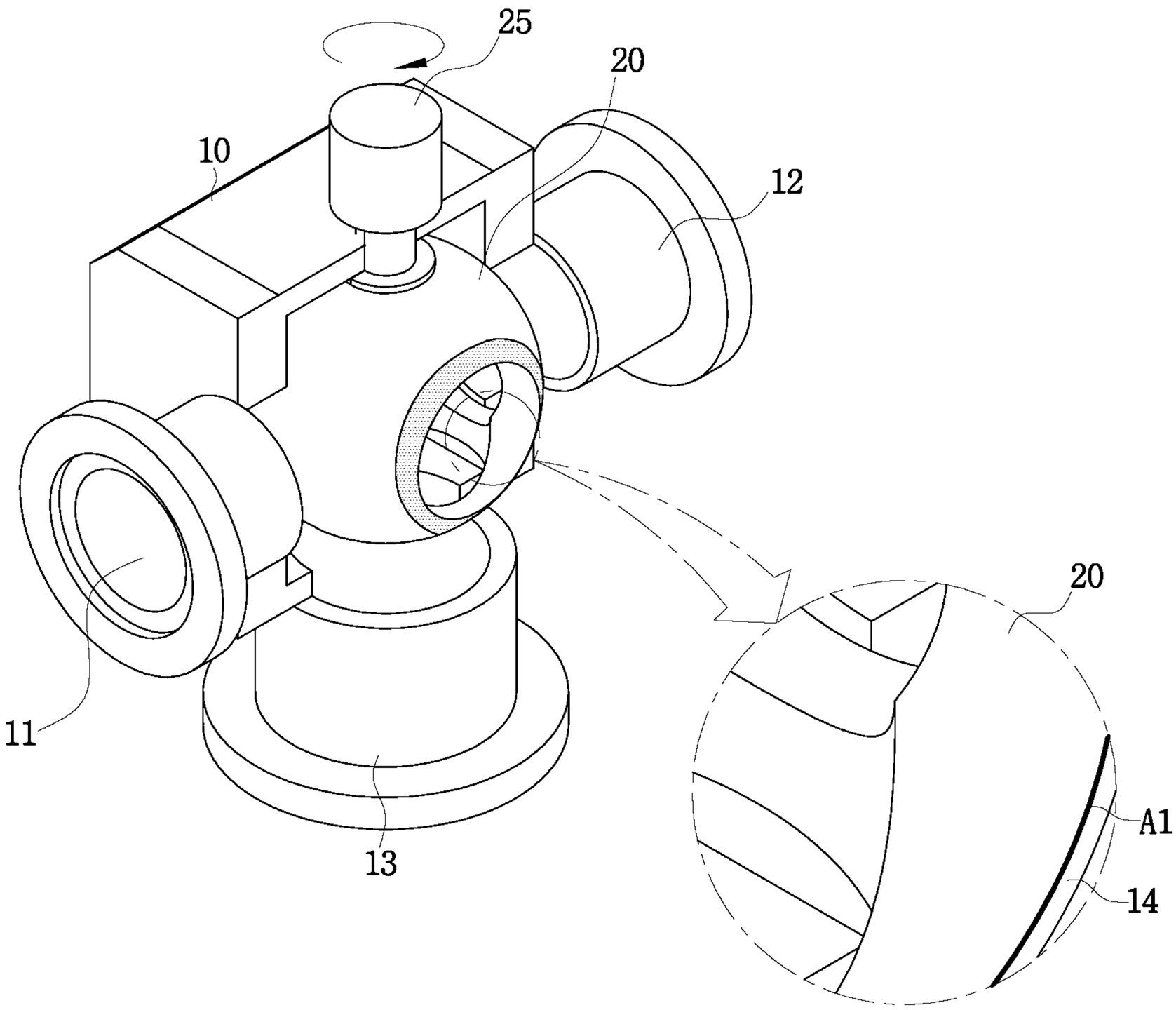


FIG. 3

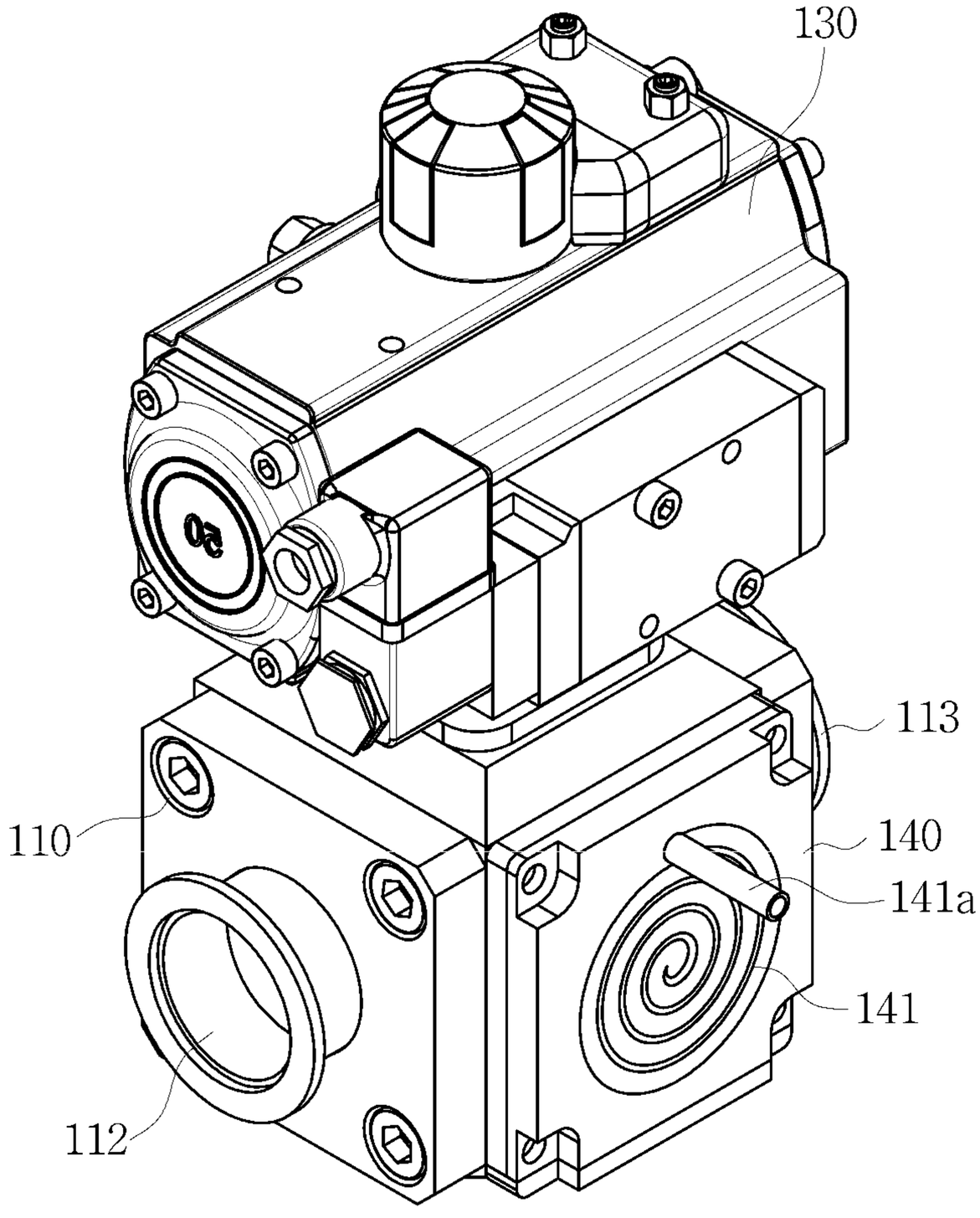


FIG. 4

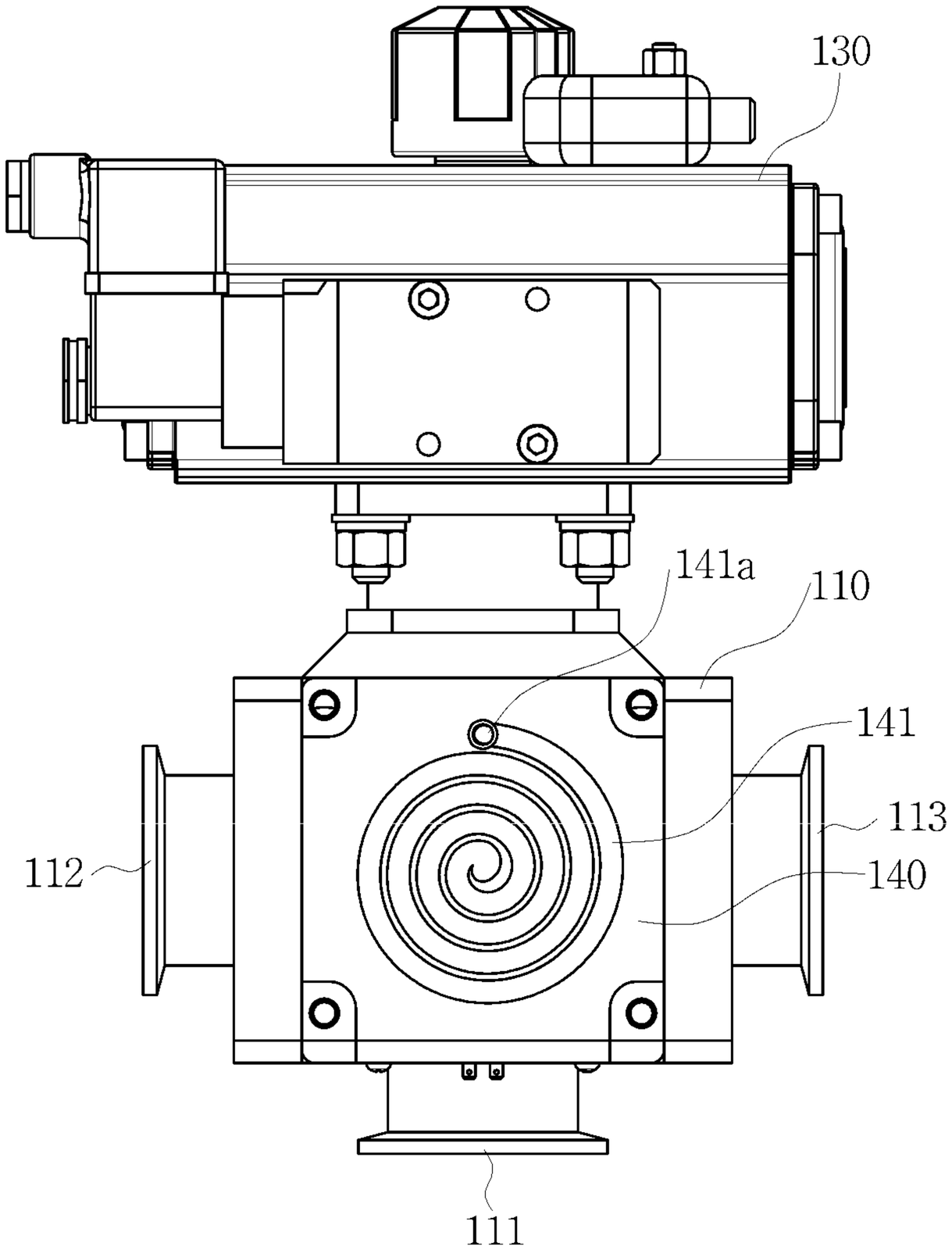


FIG. 5

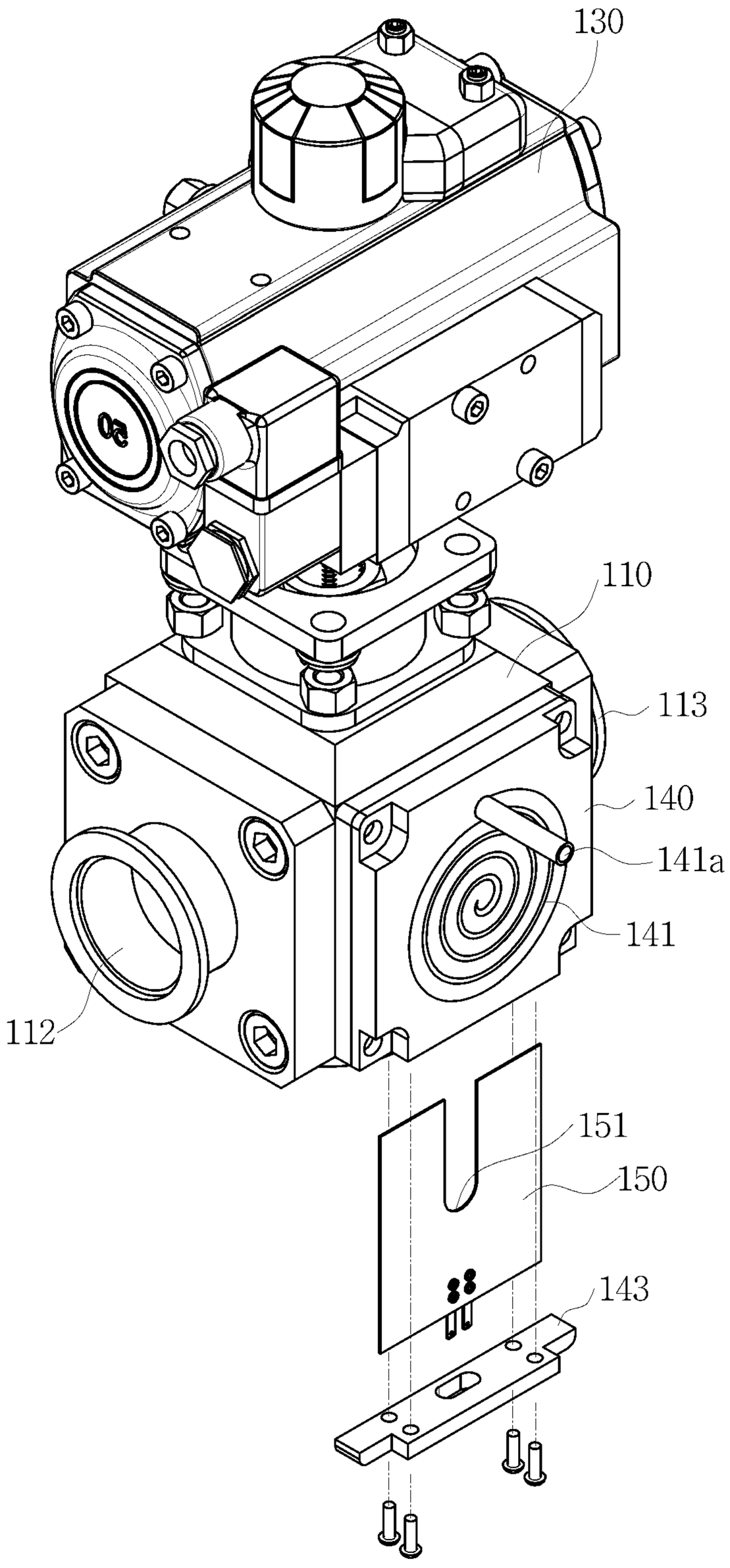


FIG. 6

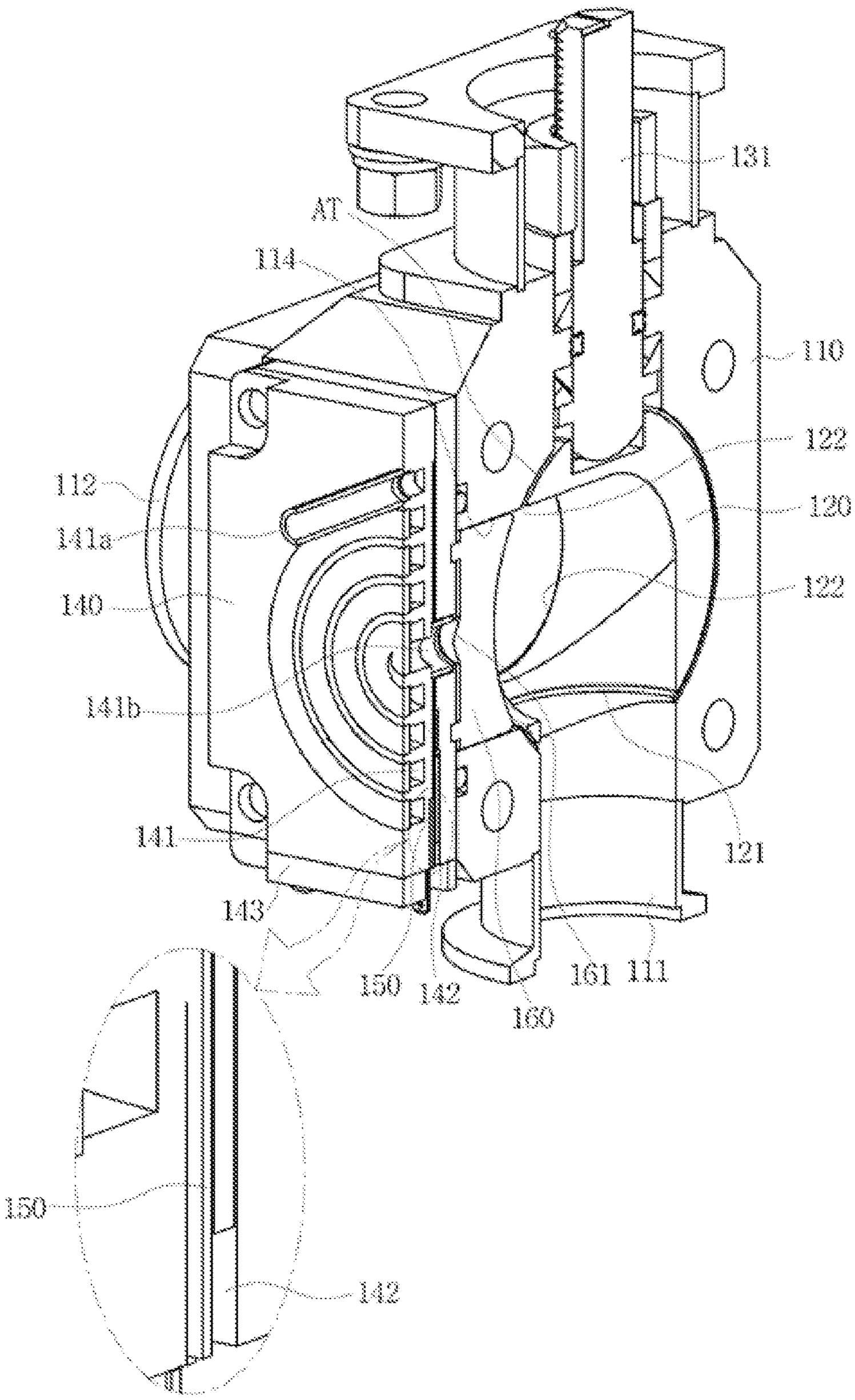

131
AT
114
110
122
112
120
141a
140
122
141b
141
121
143
161
111
150
142
160
150
142

FIG. 7

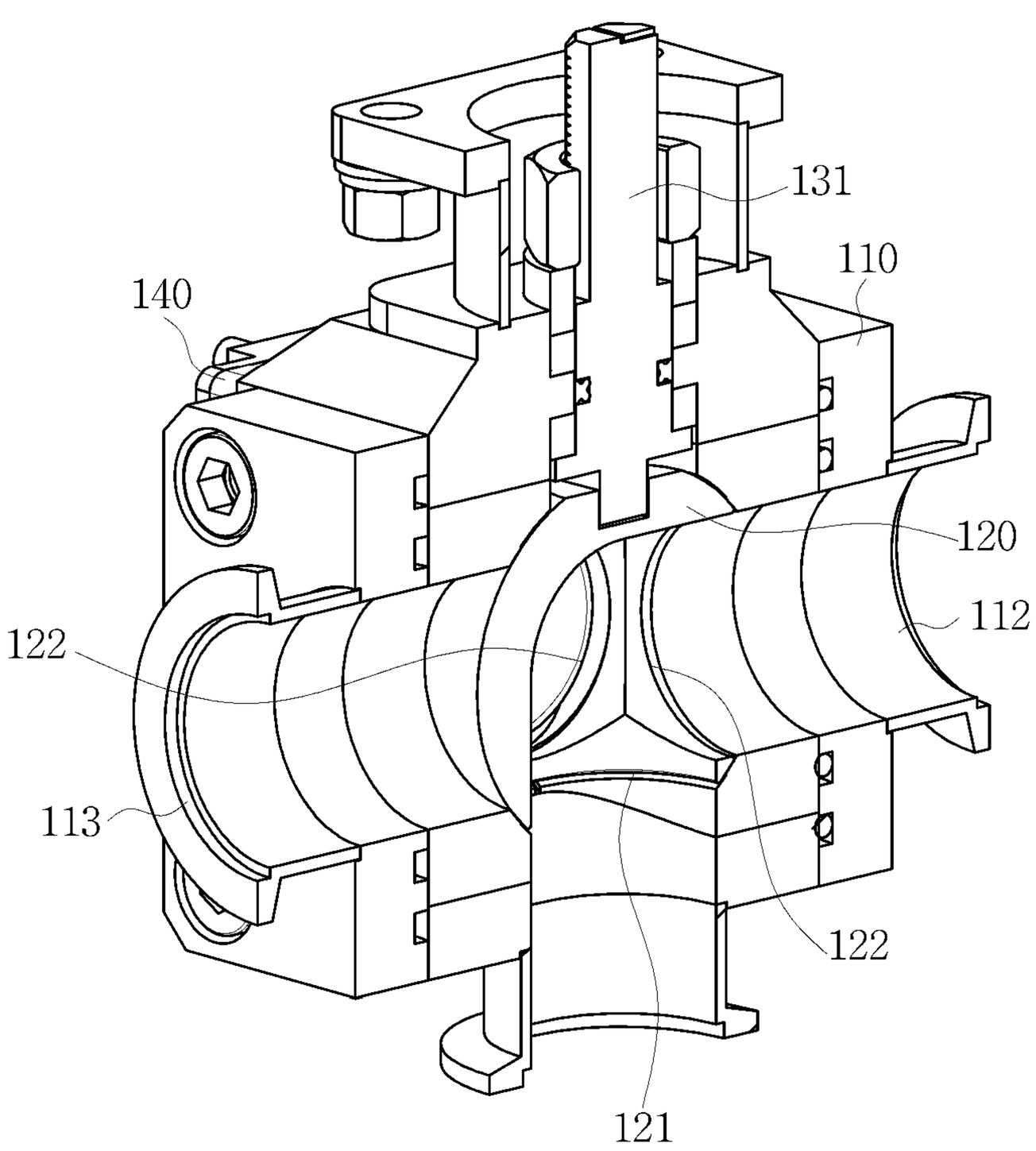


FIG. 8

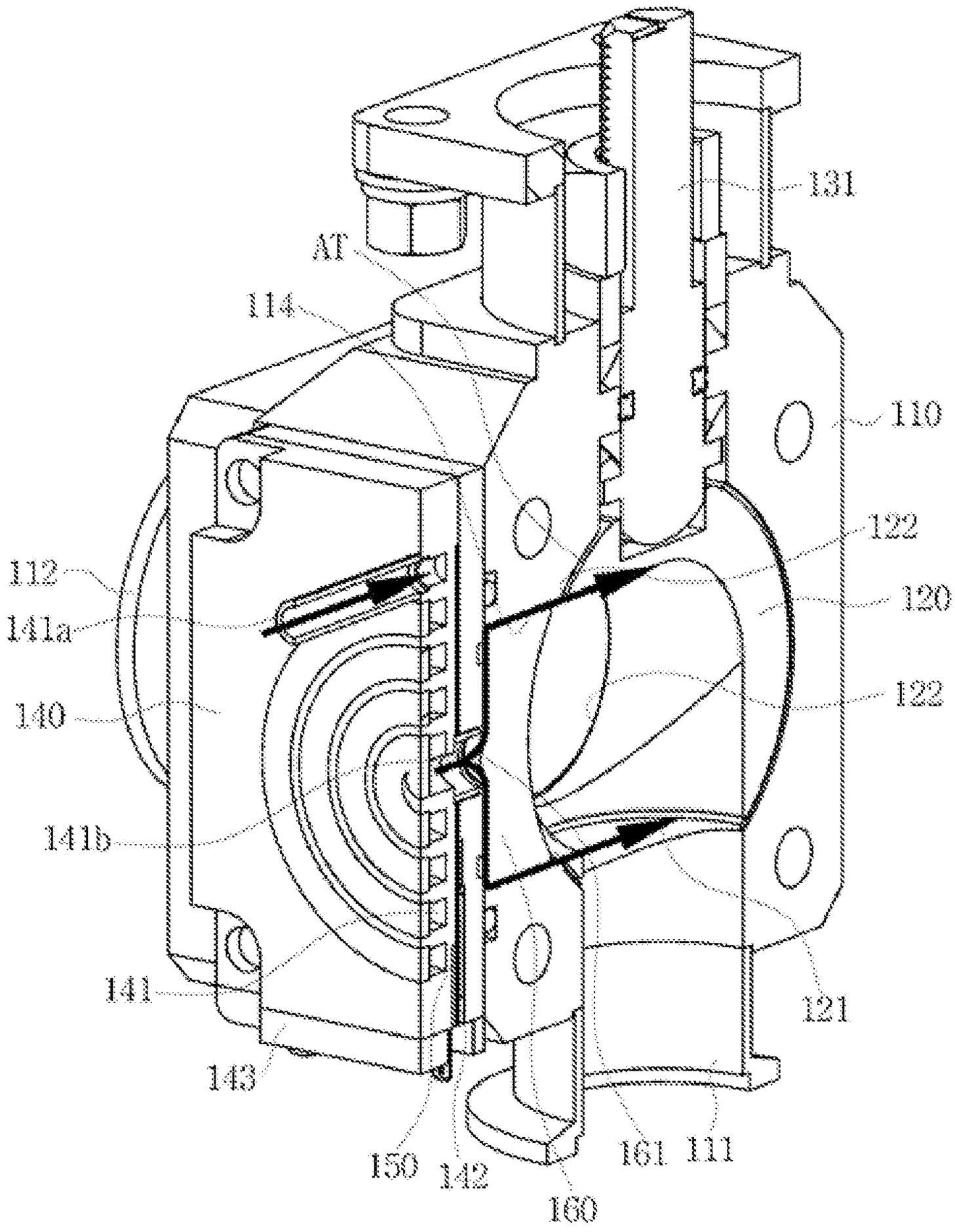
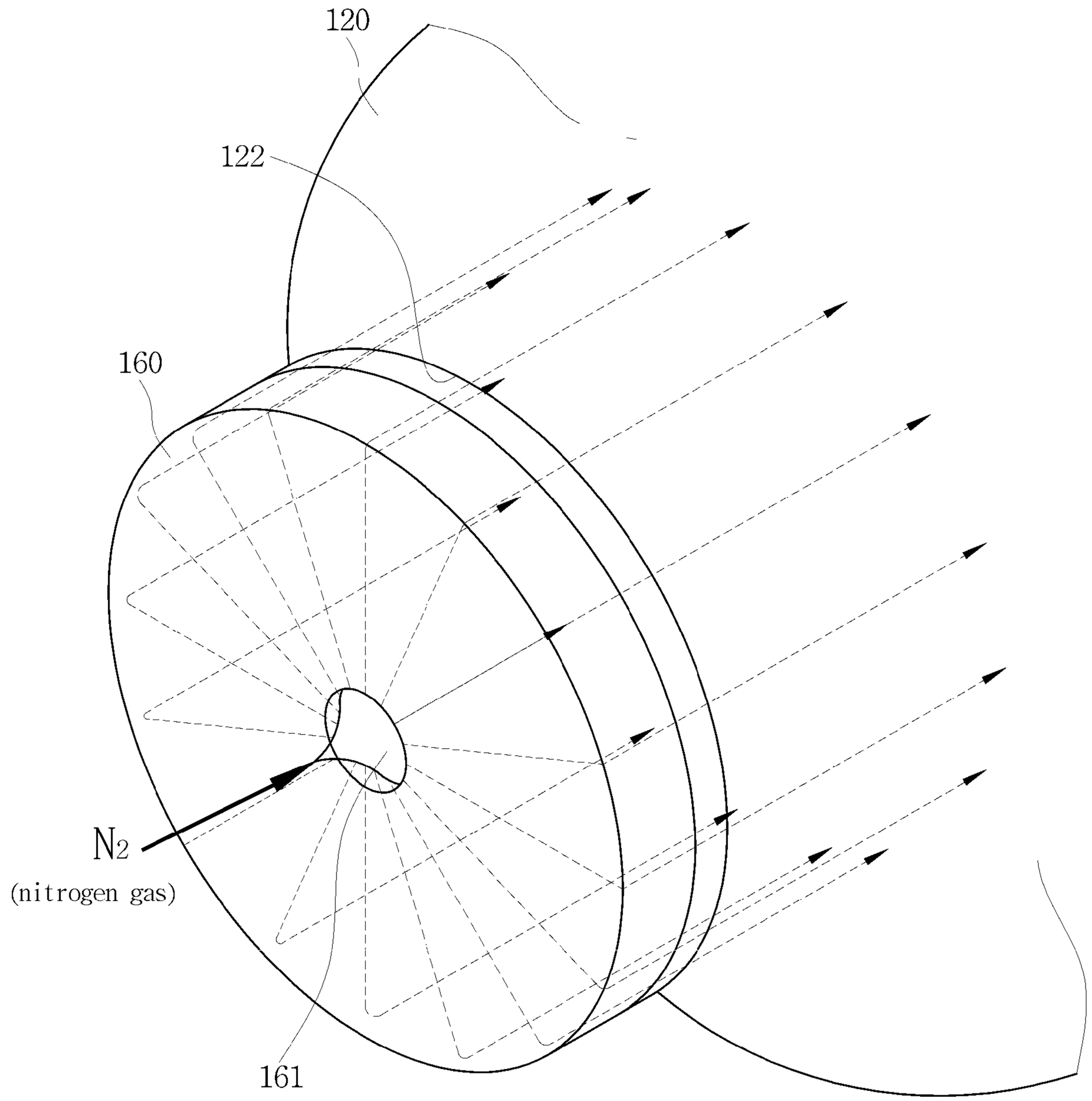

131
AT
114
110
122
112
120
141a
140
122
141b
141
121
143
150
142
161
111
160

FIG. 9



POWDER PROTECTING THREE-WAY VALVE

CROSS-REFERENCE TO PRIOR APPLICATIONS

This application is a National Stage Patent Application of PCT International Patent Application No. PCT/KR2018/011041 (filed on Sep. 19, 2018) under 35 U.S.C. § 371, which claims priority to Korean Patent Application No. 10-2017-0156637 (filed on Nov. 22, 2017), which are all hereby incorporated by reference in their entirety.

BACKGROUND

The present invention relates to a semiconductor or flat panel display manufacturing apparatus, and more particularly, to a powder protecting three-way valve which prevents a powder from being introduced into a gap between a rotating ball and a ball seat by supplying nitrogen gas in an air curtain form heated in an exhaust line of a semiconductor or flat panel display manufacturing apparatus so that the powder protecting three-way valve is usable for a long time period without damage and in which a member configured to heat and supply nitrogen gas is integrally and compactly provided instead of being separately provided as an independent member and an additional installation space is not needed.

Generally, semiconductor and flat panel display manufacturing processes mainly include fabrication processes and assembly processes, wherein the fabrication process includes processes for manufacturing semiconductor chips by repeatedly performing processes of depositing thin films on a wafer in various kinds of chambers and selectively etching the deposited thin films to form particular patterns, and the assembly process includes processes for assembling finished devices by individually separating the chips manufactured in the fabrication processes and connecting lead frames to the chips.

In this case, the process of depositing the thin film on the wafer or etching the thin film deposited on the wafer is performed in a process chamber using harmful gases such as silane, arsine, and boron chloride and process gases such as hydrogen at a high temperature, and while the process is performed, a large amount of reaction by-product gas containing various ignitable gas, corrosive foreign substances, and toxic components are generated in the process chamber.

Vacuum pumps and scrubbers which are gas treatment apparatuses are used to perform processes in such a semiconductor and flat panel display production lines, and lines which connect the vacuum pumps and the scrubbers are called exhaust lines. Three-way valves illustrated in FIGS. **1** and **2** are being widely used in the exhaust lines to control a flow direction of the reaction by-product gas and to efficiently use the scrubbers.

The three-way valve includes a casing **10** having an inlet **13** through which reaction by-product gas is introduced and a plurality of outlets **11** and **12** through which the reaction by-product gas is discharged, and a rotating ball **20** disposed in the casing **10** and configured to rotate according to rotation of a rotating shaft **25** to control a flow of the reaction by-product gas.

However, when the three-way valve used in the exhaust line in which a great deal of powder is generated is used for a predetermined time period, there is a problem in that the powder contained in the reaction by-product gas is introduced into a gap A**1** between the rotating ball **20** and a ball seat **14** supporting the rotating ball **20** and is accumulated such that the rotating ball **20** is difficult to operate. Particularly, since the powder tends to be strongly introduced into the gap between the rotating ball **20** and the ball seat **14** through a non-communication state outlet hole, which does not communicate with the outlets **11** and **12** of the casing **10**, of two outlet holes formed in the rotating ball **20**, a solution to solve the problem is needed.

SUMMARY

The present invention is directed to providing a powder protecting three-way valve which prevents a powder from being introduced into a gap between a rotating ball and a ball seat by supplying nitrogen gas in an air curtain form heated in an exhaust line of a semiconductor or flat panel display manufacturing apparatus so that the powder protecting three-way valve is usable for a long time period without damage and in which a member configured to heat and supply nitrogen gas is integrally and compactly provided instead of being separately provided as an independent member and an additional installation space is not needed.

One aspect of the present invention provides a powder protecting three-way valve including a valve casing including an inlet through which reaction by-product gas is introduced and a plurality of outlets through which the introduced reaction by-product gas is discharged in different directions, a rotating ball rotatably installed in the valve casing to control a flow direction of the reaction by-product gas, a nitrogen gas supply member which receives nitrogen gas from an outside, guides a flow of the nitrogen gas using a guide path, and supplies the nitrogen gas into the valve casing to prevent a powder contained in the reaction by-product gas from accumulating in the valve casing, and a heating unit installed in the nitrogen gas supply member to heat the nitrogen gas passing through an interior of the nitrogen gas supply member, wherein the nitrogen gas supply member is formed as a thin flat body pressed against one side surface of the valve casing and is integrally coupled to the valve casing.

In this case, the guide path of the nitrogen gas supply member may be formed in a spiral shape in which a radius is gradually decreased to increase a heating time of the heating unit.

In addition, the heating unit may be installed with a partition disposed between the heating unit and the guide path in the nitrogen gas supply member and have a width which covers a region in which the guide path is formed so that the nitrogen gas is continuously heated while flowing along the guide path.

The nitrogen gas supply member may include a cartridge slit which is installed with a partition disposed between the cartridge slit and the guide path inside the nitrogen gas supply member and have a width which covers a region in which the guide path is formed and including an inlet port which is open toward one side circumferential surface of a main body of the nitrogen gas supply member, and the heating unit may include a detachable surface heating unit having a thin film form and inserted into and installed in the cartridge slit through the open inlet port of the cartridge slit.

The heating unit may be formed to have a quadrilateral plate shape inserted into the slit and include an interference avoiding groove which is open to extend from an end portion of a circumference of the heating unit to a central portion of the heating unit to avoid interference with a nitrogen gas

spray portion formed in a central portion of the guide path when inserted into the cartridge slit of the nitrogen gas supply member.

The rotating ball may include an inlet hole which corresponds to and communicates with the inlet of the valve casing and a plurality of outlet holes which correspond to the plurality of outlets of the valve casing and selectively communicate with any one of the plurality of outlets according to a rotating direction of the rotating ball to control a flow of the reaction by-product gas in the valve casing, wherein the outlet of the valve casing and a non-communication state outlet hole of the plurality of outlet holes may be formed to face one side surface of the valve casing, and the nitrogen gas supply member may guide the nitrogen gas to flow through the non-communication state outlet hole, which faces the one side surface of the valve casing, of the plurality of outlet holes of the rotating ball so that the nitrogen gas passing through the non-communication state outlet hole may serve as an air curtain which blocks the powder contained in the reaction by-product gas from being introduced into a gap between a ball seat of the valve casing positioned adjacent to a circumferential portion of the non-communication state outlet hole and the rotating ball.

A circular opening corresponding to the non-communication state outlet hole of the rotating ball may be formed in one side wall of the valve casing, and a guide disc may be installed in the circular opening to form a gap between the guide disc and an inner circumferential surface of the circular opening so that the nitrogen gas sprayed from the nitrogen gas supply member may be dispersed after coming into contact with a front side surface of the guide disc and pass through the non-communication state outlet hole of the rotating ball while flowing in an air curtain form having a circular pipe shape along a circumferential portion of the guide disc.

In addition, a uniform gas spray portion which protrudes to have a conical shape and comes into contact with the nitrogen gas sprayed from the nitrogen gas supply member to disperse the nitrogen gas therearound may be further formed in a central portion of the front side surface of the guide disc.

According to embodiments of the present invention, since a powder protecting three-way valve supplies nitrogen gas in an air curtain form heated in an exhaust line of a semiconductor or flat panel display manufacturing apparatus to prevent a powder from being introduced into a gap between a rotating ball and a ball seat, the powder protecting three-way valve can be used for a long time period without damage.

In addition, since a member configured to heat and supply the nitrogen gas has a flat body and is integrally and compactly provided instead of being additionally and independently provided, an additional installation space is not needed.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. **1** and **2** are reference views for describing a conventional three-way valve.

FIG. **3** is a perspective view illustrating a powder protecting three-way valve according to an embodiment of the present invention.

FIG. **4** is a side view illustrating the powder protecting three-way valve according to the embodiment of the present invention.

FIG. **5** is a partially exploded perspective view for describing a detachable structure of a heating unit in the powder protecting three-way valve according to the embodiment of the present invention.

FIGS. **6** and **7** are longitudinal cross-sectional views illustrating the powder protecting three-way valve according to the embodiment of the present invention.

FIG. **8** is a reference cross-sectional view for describing an internal flow of nitrogen gas in the powder protecting three-way valve according to the embodiment of the present invention.

FIG. **9** is a reference view for describing the nitrogen gas formed in an air curtain form due to a guide disc in the powder protecting three-way valve according to the embodiment of the present invention.

DETAILED DESCRIPTION

A powder protecting three-way valve according embodiments of the present invention will be described in detail with reference to the accompanying drawings. Since the present invention allows various changes and numerous embodiments, specific embodiments will be illustrated in the drawings and described in detail in the written description. However, this is not intended to limit the present invention to the specific embodiments, and it is to be appreciated that all changes, equivalents, and substitutes that do not depart from the spirit and technical scope of the present invention are encompassed in the present invention. Like numbers refer to like elements throughout the description of the figures. In the accompanying drawings, sizes of structures may be greater than those of actual structures for clarity of the present invention or may be smaller than those of the actual structure such that a schematic structure of the present invention is understood.

It will be understood that, although the terms "first," "second," etc. may be used herein to describe various elements, these elements should not be limited by these terms. These terms are only used to distinguish one element from another element. For example, a first element could be termed a second element, and a second element could similarly be termed a first element without departing from the scope of the present invention. Meanwhile, unless otherwise defined, all terms including technical and scientific terms used herein are to be interpreted as is customary in the art to which this invention belongs. It should be further understood that terms in common usage should also be interpreted as is customary in the relevant art and not in an idealized or overly formal sense unless expressly so defined herein.

FIG. **3** is a perspective view illustrating a powder protecting three-way valve according to an embodiment of the present invention, FIG. **4** is a side view illustrating the powder protecting three-way valve according to the embodiment of the present invention, FIG. **5** is a partially exploded perspective view for describing a detachable structure of a heating unit in the powder protecting three-way valve according to the embodiment of the present invention, FIGS. **6** and **7** are longitudinal cross-sectional views illustrating the powder protecting three-way valve according to the embodiment of the present invention, FIG. **8** is a reference cross-sectional view for describing an internal flow of nitrogen gas in the powder protecting three-way valve according to the embodiment of the present invention, and FIG. **9** is a reference view for describing the nitrogen gas formed in an air curtain form due to a guide disc in the powder protecting three-way valve according to the embodiment of the present invention.

As illustrated in the drawings, the powder protecting three-way valve according to the embodiment of the present invention includes a valve casing **110**, a rotating ball **120**, and an actuator **130**, and further includes a nitrogen gas supply member **140**, a heating unit **150**, and a guide disc **160** as main components which heat nitrogen gas at a high temperature and supply the nitrogen gas into the valve casing **110**.

Due to such a structure according to the present invention in which the nitrogen gas supply member **140**, the heating unit **150**, and the guide disc **160** are additionally provided, heated nitrogen gas is mixed with reaction by-product gas such that the reaction by-product gas is not solidified, the nitrogen gas serves as an air curtain to block a powder from being introduced into a gap between the rotating ball **120** and a ball seat of the valve casing **110** when the nitrogen gas is supplied, and the components have a unique structure integrally provided to have a flat plate shape on one side surface of the valve casing **110** without being additionally and independently provided so that a compact product can be realized which does not require an additional installation space.

Hereinafter, the powder protecting three-way valve including the main components according to the embodiment of the present invention will be described in more detail.

The valve casing **110** includes an inner space accommodating the rotating ball **120**, an inlet **111** through which the reaction by-product gas is introduced and a plurality of outlets **112** and **113** through which the introduced reaction by-product gas is discharged in different directions with respect to the inner space. In addition, the inlet **111** and the outlets **112** and **113** include flanges to be connected to other pipes. In this case, the ball seat rotatably supporting the rotating ball **120** is provided on an inside of walls of the valve casing **110**. In addition, a circular opening **114** corresponding to a non-communication state outlet hole **122** of the rotating ball **120** is formed in one side wall of the walls of the valve casing **110**. The circular opening **114** is a passage through which the nitrogen gas supplied from the nitrogen gas supply member **140** is received in the valve casing **110**.

The rotating ball **120** is rotatably installed in the inner space of the valve casing **110** to perform a function of controlling a flow direction of the reaction by-product gas. To this end, the rotating ball **120** includes one inlet hole **121** which normally communicates with the inlet **111** of the valve casing **110** and a plurality of outlet holes **122** which correspond to the plurality of outlets **112** and **113** included in the valve casing **110** and selectively communicate with any one of the plurality of outlets **112** and **113** according to a rotating direction of the rotating ball **120**. Accordingly, the rotating ball **120** connected to a rotating shaft **131** of the actuator **130** rotates to control the flow direction of the reaction by-product gas by performing a function of selectively closing or opening any one of the plurality of outlets **112** and **113** formed in the valve casing **110** according to a rotating angle of the rotating ball **120**. Since the rotating ball **120** is substantially the same as that of a conventional technology, the detailed description thereof will be omitted. However, the rotating ball **120** included in the powder protecting three-way valve according to the embodiment of the present invention has few problems due to a solidified powder introduced into the gap between the rotating ball **120** and the ball seat of the valve casing **110** and accumulated in the gap such that the rotating ball **120** is damaged or enters an inoperative state. This is because the high temperature nitrogen gas is introduced into the valve casing **110** from the nitrogen gas supply member **140** through the non-communication state outlet hole **122** of the outlet holes **122** of the rotating ball **120** to serve as the air curtain which blocks the powder of the reaction by-product gas from being introduced into the gap between the rotating ball **120** and the ball seat in the non-communication state outlet hole **122**. This will be described in more detail below.

The nitrogen gas supply member **140** serves to receive nitrogen gas from the outside and guides the nitrogen gas to flow inward. To this end, the nitrogen gas supply member **140** includes a guide path **141** configured to guide a flow of nitrogen gas, and the guide path **141** is formed to have a spiral shape in which a radius is gradually decreased as illustrated in the drawings. When the nitrogen gas supply member **140** includes the guide path **141** having the spiral shape as described above, a heating time of the heating unit **150** for heating nitrogen gas is increased so that heating efficiency can be improved. In this case, an inlet portion **141***a* connected to an external transfer pipe to receive nitrogen gas is positioned at an end portion positioned at a circumferential portion of the guide path **141**, and a spray portion **141***b* configured to spray nitrogen gas into the valve casing **110** through the non-communication state outlet hole **122** of the rotating ball **120** is positioned at an end portion positioned at a central portion of the guide path **141**.

A notable point in this case is that nitrogen gas is supplied through the non-communication state outlet hole **122** of the rotating ball **120** when the nitrogen gas supply member **140** supplies the nitrogen gas into the valve casing **110** through the guide path **141**. Accordingly, a trend in which the reaction by-product gas is intensively introduced into the gap between the ball seat of the valve casing **110** and the rotating ball **120** at a position at which the non-communication state outlet hole **122** of the rotating ball **120** is positioned is prevented by the nitrogen gas passing through the non-communication state outlet hole **122**. In this case, the nitrogen gas passing through the non-communication state outlet hole **122** of the rotating ball **120** serves as the air curtain which blocks the reaction by-product gas from being introduced into the gap between the ball seat of the valve casing **110** and the rotating ball **120**.

In addition, the guide disc **160** maximizes the role of an air curtain of such nitrogen gas. As illustrated in FIG. **6**, the guide disc **160** is installed in the circular opening **114** formed to correspond to the non-communication state outlet hole **122** of the rotating ball **120** in one side wall of the valve casing **110**. In this case, the guide disc **160** is provided to have a size slightly smaller than a size perfectly matching the circular opening **114** so that a fine gap is formed between an inner circumferential surface of the circular opening **114** and an outer circumferential surface of the guide disc **160**. Accordingly, as illustrated in FIGS. **8** and **9**, nitrogen gas sprayed from the nitrogen gas supply member **140** is dispersed after coming into contact with a front side surface of the guide disc **160** and passes through a circumferential portion of the non-communication state outlet hole **122** of the rotating ball **120** while flowing in an air curtain form having a circular pipe shape along a circumferential portion of the guide disc **160**. In this case, a uniform gas spray portion **161** which protrudes in a conical shape and serves to come into contact with the nitrogen gas sprayed from the nitrogen gas supply member **140** so as to uniformly disperse the nitrogen gas therearound is further formed in a central portion of the front side surface of the guide disc **160**. Due to the structure in which the guide disc **160** is provided, the nitrogen gas flows in a circular pipe shape at a relatively

high speed along the circumferential portion of the non-communication state outlet hole **122** of the rotating ball **120** to more strongly block the reaction by-product gas from being introduced into the gap between the ball seat of the valve casing **110** and the rotating ball **120**.

The heating unit **150** is installed in the nitrogen gas supply member **140** to perform a function of heating nitrogen gas passing through an interior of the nitrogen gas supply member **140**. To this end, the heating unit **150** is installed in the nitrogen gas supply member **140** and provided to have a quadrilateral plate shape having a width which covers an entire region in which the guide path **141** is formed, wherein a partition is disposed between the heating unit **150** and the guide path **141**. In addition, the heating unit **150** includes an interference avoiding groove **151** which is open to extend from an end portion of a circumference of the heating unit **150** to a central portion of the heating unit **150** to prevent interference with the nitrogen gas spray portion **141***b* formed on the central portion of the guide path **141**. The heating unit **150** having such a structure continuously heats nitrogen gas while the nitrogen gas flows along the guide path **141** having the spiral shape.

In addition, as illustrated in FIG. **6**, since the heating unit **150** is provided as a detachable surface heating unit having a thin film form, a thickness of the nitrogen gas supply member **140** can be minimized, and installation and replacement of the nitrogen gas supply member **140** can be convenient. A cartridge slit **142** corresponding to the detachable structure of the heating unit **150** is formed in the nitrogen gas supply member **140**, has a width which covers a region in which the guide path **141** is formed, and includes an inlet port which is open toward one side circumferential surface of a main body of the nitrogen gas supply member **140**, wherein a partition is disposed between the cartridge slit **142** and the guide path **141**. Accordingly, the detachable heating unit **150** having the thin film form is inserted into and installed in the cartridge slit **142** through the open inlet port of the cartridge slit **142**. For reference, as illustrated in FIG. **5**, a slit cover **143** which covers the inlet port of the cartridge slit **142** in a state in which the heating unit **150** is installed may be provided.

Although the exemplary embodiments and other embodiments have been described, the present invention may be variously changed and modified and may include equivalents. It is clear that the embodiments may be suitably modified and similarly applied to the present invention. Accordingly, the above-described contents are not to be limited by the scope of the present invention but defined by the following claims.

The invention claimed is:

1. A powder protecting three-way valve installed in a line of a semiconductor or flat panel display manufacturing apparatus to control a flow of reaction by-product gas containing a powder, the powder protecting three-way valve comprising:

a valve casing including an inlet through which the reaction by-product gas is introduced and a plurality of outlets through which the introduced reaction by-product gas is discharged in different directions;

a rotating ball rotatably installed in the valve casing to control a flow direction of the reaction by-product gas;

a nitrogen gas supply member which receives nitrogen gas from an outside, guides a flow of the nitrogen gas using a guide path, and supplies the nitrogen gas into the valve casing to prevent the powder contained in the reaction by-product gas from accumulating in the valve casing; and

a heater installed in the nitrogen gas supply member to heat the nitrogen gas passing through an interior of the nitrogen gas supply member,

wherein the nitrogen gas supply member is formed as a thin flat body pressed against one side surface of the valve casing and is integrally coupled to the valve casing.

2. The powder protecting three-way valve of claim **1**, wherein the guide path of the nitrogen gas supply member is formed in a spiral shape in which a radius is gradually decreased to increase a heating time of the heater.

3. The powder protecting three-way valve of claim **2**, wherein the heater is installed with a partition disposed between the heater and the guide path in the nitrogen gas supply member and has a width which covers a region in which the guide path is formed so that the nitrogen gas is continuously heated while flowing along the guide path.

4. The powder protecting three-way valve of claim **2**, wherein:

the nitrogen gas supply member includes a cartridge slit which is installed with a partition disposed between the cartridge slit and the guide path inside the nitrogen gas supply member and has a width which covers a region in which the guide path is formed and including an inlet port which is open toward one side of a circumferential surface of a main body of the nitrogen gas supply member; and

the heater includes a detachable surface heater having a thin film form and inserted into and installed in the cartridge slit through the open inlet port of the cartridge slit.

5. The powder protecting three-way valve of claim **4**, wherein the heater is formed to have a quadrilateral plate shape inserted into the slit and includes an interference avoiding groove which is open to extend from an end portion of a circumference of the heater to a central portion of the heater to avoid interference with a nitrogen gas spray portion formed in a central portion of the guide path when inserted into the cartridge slit of the nitrogen gas supply member.

6. The powder protecting three-way valve of claim **1**, wherein the rotating ball includes an inlet hole which corresponds to and normally communicates with the inlet of the valve casing and a plurality of outlet holes which correspond to the plurality of outlets of the valve casing and selectively communicate with any one of the plurality of outlets according to a rotating direction of the rotating ball to control a flow of the reaction by-product gas in the valve casing,

wherein the outlet of the valve casing and a non-communication state outlet hole of the plurality of outlet holes are formed to face one side surface of the valve casing; and

the nitrogen gas supply member guides the nitrogen gas to flow through the non-communication state outlet hole, which faces the one side surface of the valve casing, of the plurality of outlet holes of the rotating ball so that the nitrogen gas passing through the non-communication state outlet hole serves as an air curtain which blocks the powder contained in the reaction by-product gas from being introduced into a gap between a ball seat of the valve casing positioned adjacent to a circumferential portion of the non-communication state outlet hole and the rotating ball.

7. The powder protecting three-way valve of claim **6**, wherein:

a circular opening corresponding to the non-communication state outlet hole of the rotating ball is formed in one side wall of the valve casing; and

a guide disc is installed in the circular opening to form a gap between the guide disc and an inner circumferential surface of the circular opening so that the nitrogen gas sprayed from the nitrogen gas supply member is dispersed after coming into contact with a front side surface of the guide disc and passes through the non-communication state outlet hole of the rotating ball while flowing in an air curtain form having a circular pipe shape along a circumferential portion of the guide disc.

8. The powder protecting three-way valve of claim **7**, wherein a uniform gas spray portion which protrudes to have a conical shape and comes into contact with the nitrogen gas sprayed from the nitrogen gas supply member to disperse the nitrogen gas therearound is further formed in a central portion of the front side surface of the guide disc.

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